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# Description

# Shaping Tool for Plastic Housing Parts

## Background of Invention

[0001] 1. Field of the Invention.

[0002] The invention relates to a shaping or molding tool for manufacturing plastic housing parts for electrical devices, wherein the shaping tool (molding tool) is comprised of a frame and at least one cavity member arranged within the frame.

[0003] The invention also relates to a method for manufacturing a shaping tool for plastic housing parts.

[0004] 2. Description of the Related Art.

[0005] For the purpose of manufacturing plastic housing parts for electrical devices, special requirements are to be observed. Since the housing parts are used for expensive technical devices, the housing parts must visually give the appearance of high quality processing standards and must be visually flawless. The electrical or electronic devices usually have several displays and operating function keys

for which matching openings must be provided in the plastic housing parts. The openings must be cast with a high degree of precision either because otherwise mounting of the housing parts on the electronic components is impossible or because improper fit impairs proper functioning of the device or reduces the impression of quality. The housing parts have moreover difficult geometries with arched or curved surfaces and undercuts which pose additional requirements with regard to the precision of the manufacturing process.

[0006] In order to oblige with the high-quality requirements in regard to the device housing parts, it is known in the prior art to configure one tool for one component, respectively. The tool is manufactured of a single-piece frame into which one or several cavity elements can be mounted. The completed module is then inserted into the injection molding machine and the housing parts are manufactured by injection molding in the machine.

[0007] This manufacturing process for the shaping tools has disadvantages. For example, the process for manufacturing the entire shaping tool, i.e., cavity element and frame including the required ejectors and inner and outer slides, requires a great expenditure of time which delays the start

of the production process. Moreover, in the case of growing production numbers of the housing parts, the single shaping tool manufactured in this way is not suitable for further use in double cavity, four-fold cavity or other shaping tool configurations. For this purpose, a new manufacturing process is required because the first tool that has been produced cannot be reused at all or a conversion would require significant expenditure. In the case of constructive changes of the housing parts, move of the production sites, and tool change, such conventional shaping tools were found to be difficult and cumbersome to handle. An adaptation or retooling of the conventional tools is possible only with great expenditure. Since the components of the shaping tool cannot be used again or can be reused only in connection with a hardly justifiable economic expenditure, it is necessary to produce a completely new shaping tool at high expenditure when production of a new housing part is to begin or when production is to be increased by means of multiple tools (tools producing several products at once). The system of tool manufacture is therefore overall not flexible enough and too complex.

## Summary of Invention

[0008] It is an object of the present invention to reduce the expenditure for manufacturing shaping tools and to increase flexibility with regard to production.

[0009] In accordance with the present invention, this is achieved in that the frame and the cavity element are detachably mounted on a tool structure, in that the frame is comprised of several individual frame parts of which a lateral surface rests against the longitudinal or transverse lateral surfaces of the cavity element, respectively, wherein the individual frame parts and the cavity element have recesses whose sidewalls are flatly seated against the lateral surfaces of sliding blocks, which are connected detachably to the tool structure.

[0010] According to another embodiment, the cavity element and the individual frame parts of the frame are detachably mounted on the tool structure and the dimensions of the cavity element of the individual frame parts, and of the tool structure are matched to one another such that the cavity element and the individual frame parts can be identically mounted to generate a single, double or quadruple cavity tool or other multiple cavity tool.

[0011] According to yet another embodiment, this is achieved in that the structural components of the cavity element, of

the tool structure, and of the individual frame parts are detachably connected to one another and in that each structural component, in combination with other structural components having the same structural component-specific shape, can be mounted to generate a new tool.

[0012] In connection with the method of the present invention, the object is achieved in that at least one cavity element and individual frame parts of the frame are detachably mounted as individual structural components on the tool structure.

[0013] When applying the suggested modular concept for manufacturing the tool, individual cavity elements can be removed from a tool structure and can be used in other tool structures. In this way, it is possible to start production initially with a single cavity element; when production is to be increased because of growing sales of the product, a second cavity element is prepared and both cavity elements are mounted in one shaping tool. The manufacturing time for manufacturing the new tool is extremely short because only the second cavity element must be made. The first cavity element, the individual structural components, and the tool structure are present as elements of a modular system and must not be manufac-

tured separately. In this way, storing capacities for shaping tool blanks and complete parts can be significantly reduced; the retooling expenditure for the shaping tool is significantly reduced when in the case of a change in the shape of the housing part to be produced only a single cavity element must be inserted.

[0014] The tool structures and individual structural components of the frame in principle can be reused and accelerate the manufacture of a new tool for new shaped housing parts. In the case of manufacturing housing parts at several production sites, the production processes can be flexibly adjusted to the local production requirements because it is sufficient to exchange only the cavity elements between the individual production sites. In contrast to complete shaping tools, cavity elements can be shipped as packages by express mail or courier. As a result of the high flexibility with respect to the tool, inexpensive manufacturing costs, which are essentially independent of the difficult-to-foresee numbers of pieces to be produced, can be offered to customers who want to manufacture housing parts.

## Brief Description of Drawings

[0015] Fig. 1 is a cross-section of a portion of the shaping tool

according to the invention.

[0016] Fig. 2 is a further cross-section of the shaping tool.

[0017] Fig. 3 is a detail view of a cavity element of the shaping tool.

[0018] Fig. 4 is a perspective view of the shaping tool at the ejector side.

[0019] Fig. 5 is a perspective view of the shaping tool at the hot side.

## Detailed Description

[0020] Fig. 1 is a cross-section of a complete shaping tool. A cavity element 4 is mounted on a tool structure 2, i.e., a cavity member 4a is provided on the ejector side and a cavity member 4b is provided on the hot side. The tool structure 2 on the ejector side includes an ejector plate 6 with ejectors 8. The ejector side in this tool structure 2 is provided with channels 10 for the ejectors. The contour-forming shaping surfaces 12 of the cavity members 4a, 4b form between them a hollow space or cavity which must be filled with plastic material for producing plastic housing parts. The complex contour of the housing part with undercut can be easily seen in the Fig. 1. When the injection process is complete, the cavity members 4a, 4b of the

cavity element 4 are moved apart. The ejector slide 14 is moved by means of the slantedly positioned guide pins to the exterior. At the same time, the ejectors 8 are moved by the ejector plate 6 into an ejection position where the inner slide 22 finally pivots inwardly and in this way the finished plastic housing part can be removed from the ejectors. The cavity element 4 is essentially formed by the insert 16 into which the core 18 with the contour-forming shaping surface 12 is inserted.

[0021] In Fig. 2, a cross-section of a complete shaping tool can be seen. The ejector side A and the hot side B are to be differentiated. When the tool is in the closed position, the structural components of the cavity element and of the individual frame parts 20 are located opposite one another in the area c. The cavity elements 4 and the individual frame parts 20 are fastened on a tool structure 2 arranged in the area d. The hot side B has in addition a hot channel system in the area e. The cavity elements 4 are secured by sliding blocks 21. Instead of sliding blocks 21, one of the components cavity elements 4, individual frame parts 20, and tool structure 2 can have a shaped portion (projection), for example, a cube or a parallelepiped, which projects past the contacting surfaces and is posi-

tioned such that, in accordance with the modular concept, it can project into the matching recesses 28 of neighboring components. The arrangement of the ejectors 8 on the ejector plate 6 can be seen very well in the illustration; the ejectors 8 project into the channels 10 provided for the ejectors, respectively. The position of the inner slide 22 is also illustrated.

[0022] The heated plastic material is injected through the hot channel 24 into the cavity element formed peripherally by the contour-forming shaping surfaces 12. Moreover, channels 26 for heating/cooling of the tool are illustrated which extend from the tool structure 2 into the cavity element 4.

[0023] Fig. 3 shows a perspective illustration of a cavity element 4. For reasons of simplification of the drawing, the ejectors 8 and the outer slide 14 are not illustrated. Illustrated are however the channels 10 for the ejectors 8 which open into the contour-forming shaping surfaces 12 and extend into the core 18. The insert 16 has recesses 28 for receiving drive elements for controlling slides.

[0024] Fig. 4 shows a shaping tool at the ejector side. As an example, the cavity member 4a is illustrated which is attached to the tool structure 2. Adjacent, a recess in the

tool structure 2 is illustrated into which an additional cavity member 4a can be inserted. Also visible is the hole pattern of the openings of the channels 10 for the ejectors and those of the cooling or heating channels, inner slide or other elements. The cavity member 4a is secured in its position by laterally adjoining individual frame parts 20 which rest with their lateral surfaces flat against the lateral surfaces of the cavity member 4a. The illustrated double cavity tool can be combined with an identically constructed additional double cavity tool so that a quadruple cavity tool will result.

[0025] A detachable cavity member 4a connected to the tool structure 2 can be detached easily from the tool structure and mounted in a different shaping tool which has a hole pattern matching that of the cavity member 4a. The shaping tools configured according to a modular design can also be used as a single cavity shaping tool, a double cavity shaping tool, a quadruple cavity shaping tool in shaping tools for injection molding machines with rotary stack technology, rotary technology or with stack tools. The technology can be used also when a plastic housing part of several plastic materials is to be produced and several injection molding processes are required for manufactur-

ing a finished housing part.

[0026] Fig. 5 shows a shaping tool used on the hot side. A nozzle 30, onto which a cavity member 4b must still be placed, is illustrated. On the left side the completed mounting position of the cavity member 4b is illustrated. Als illustrated are the recesses 28 in the surface of the tool structure 2 and on the exterior surface of the cavity member 4b facing the tool structure 2.

[0027] The shaping tool according to the invention can be mounted in a simple way. For building a complete tool, it is only necessary that initially one cavity element 4, i.e., its cavity members 4a, 4b, is shaped and hardened. As soon as this structural component is available, the cavity members 4a, 4b must only be screwed onto the desired tool structure 2 or attached in any other suitable way. On the exterior, the cavity elements 4 are delimited by individual frame parts 20 of the frame. The individual frame parts 20 as well as the tool structure 2 can be standardized structural components which are stocked and which can be exchanged easily. The connection between the individual structural components or modules is carried out preferably by screw connections, but any other suitable detachable type of connection can be used.

[0028] In the embodiment, the shaping tools are used for manufacturing plastic housing parts for mobile phones. The cavity element sizes are within the range of 130 x 200 mm to 100 x 200 mm. For other housing dimensions, the dimensions of the cavity elements can be matched accordingly. The same holds true for positioning the inner and outer slides as well as the ejectors. Since, independent of the manufacturer, the dimensions of typical electronic devices, such as mobile phones, CD players, cordless phones, car stereo devices, watches and clocks, portable computers and similar devices, are often almost identical, the tool structures with the receptacles for the cavity elements with certain dimensions can be reused when new cavity elements are produced in shaping tools for manufacturing housing parts for other devices, in some cases even for different clients. The same holds true for the individual frame parts 20 of the frame which can also be reused.

[0029] While specific embodiments of the invention have been shown and described in detail to illustrate the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.